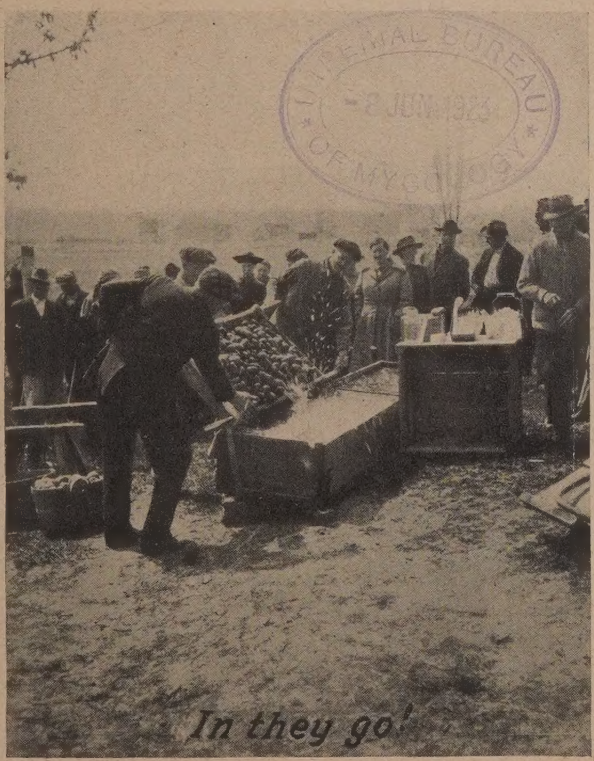
Bulletin 331 Brann J. W. & Vaughan R.E. April, 1921

Potato Scab



AGRICULTURAL EXPERIMENT STATION
OF THE UNIVERSITY OF WISCONSIN
MADISON

DIGEST

Potato scab is widespread in Wisconsin. It injures the appearance of potatoes for the table and reduces the quality of seed stock.
Pages 3–5

Corrosive sublimate seed treatment is one of the important ways of controlling potato scab. The tubers selected for seed should be soaked in a 1–1000 solution for 1½ hours while dormant and before cutting. Pages 6–7 and 10–19

Formaldehyde seed treatment is also used with some success.
Page 7

Other helps in scab control are the selection of scab-free seed, rotation of crops, selection of scab-free soil, and absence of heavy applications of lime, ashes, or fresh manure just previous to planting.
Pages 8–10 and 22–24

Disinfection experiments form the basis for the directions regarding scab control; see inside back cover and Pages 10–19

Corrosive sublimate loses strength when used for treating successive lots of potatoes. The strength should be maintained by adding ¼ to ½ ounce of the chemical after every 4 bushels treated.
Pages 20–22

Rural New Yorker is the freest from scab of all standard Wisconsin varieties. The varieties used, named in order of increasing scabbiness, are: Burbank, Green Mountain, Early Ohio, Triumph, and Irish Cobbler. Pages 25–26

Potato Scab

J. W. Brann and R. E. Vaughan

POTATO seed disinfection is one of the most effective and practical means of reducing scab. Its object is to kill the scab organisms on the surface of the tubers and thus prevent infection of the soil and of the following crop. This is especially true where the soil is free or relatively free from the disease germs.

In Wisconsin, as in most other northern potato states, scab is the most important disease with which the potato grower has to contend. The loss from this disease is difficult to estimate but considerable sorting for scab is necessary each season at all loading stations and on many farms in some localities. The value of the crop, either for table or seed stock, may often be directly reduced because of the unsightly appearance of the scabby tubers.

Wisconsin is producing a large amount of seed potatoes each year. Farmers raising this stock are especially concerned with scab because it reduces the production of tubers of high quality. Sections of the state recently opened to farming have little or no scab, but all growers throughout the state and especially those in the older potato sections must practice the best methods of seed selection, culture, and disease control in order to maintain the standards for table and seed stock.

Appearance of Scab

Diseased tubers show roughened and corked areas ranging from small spots to a general infection of the entire surface. The disease appears either as a raised surface or a slightly depressed area. Other types of injury are often confused with the true scab.

Deep scab, characterized by deep irregular corked areas, is no doubt associated with injury by wire worms, white grubs, mites, or thousand legged worms. It is generally supposed that these insects prefer to enter at the diseased areas.

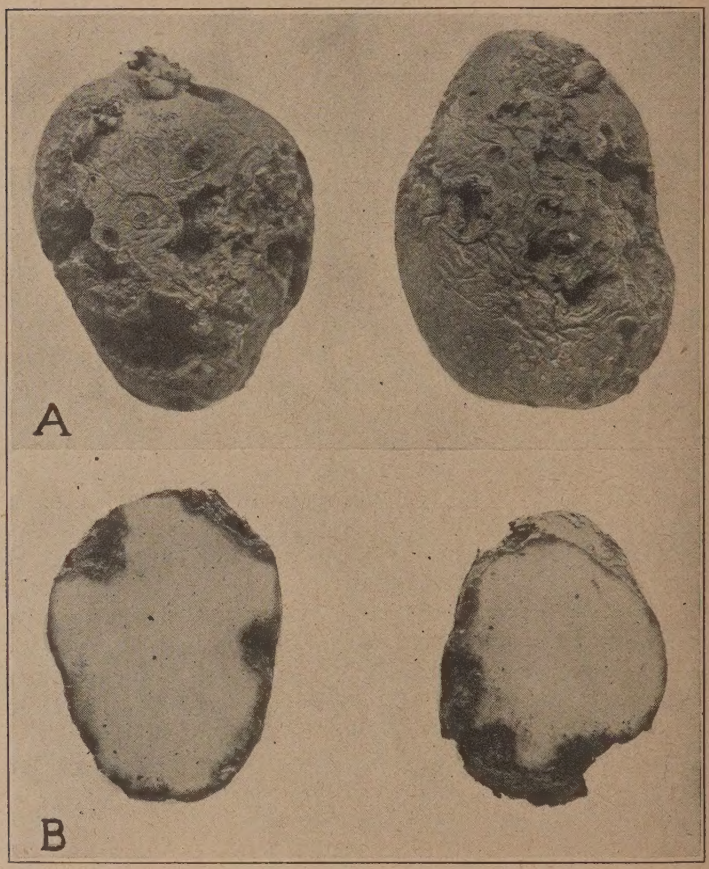


FIG. 1.—POTATO SCAB INJURES THE APPEARANCE AND QUALITY OF TUBERS

A—Deep scab increased by insect attack.
B—Cross sections of badly scabbed tubers. Wire worms, white grubs, and larvae of other insects often feed on potatoes injured by scab.

A condition quite similar to scab appears to be induced when the growing potato comes in contact with roots, stones, or other obstructions to normal growth.

A checked or corrugated surface much like scab may be caused by soil conditions and reactions resulting from application of chemicals, such as lime and ashes.

Enlarged lenticels, enlarged openings in the skin, which assume a corky appearance in older stages, are sometimes conspicuous on the Early Ohio and Triumph varieties. This condition has been observed on potatoes grown in wet soil or soil in which the temperature is abnormally high. It is not usually very serious.

FIG. 2.—ENLARGED LENTICELS

This appearance is most noticeable on the Triumph variety especially when grown on wet soil or at high temperature. It is often confused with scab.

CAUSE AND SPREAD OF POTATO SCAB

Potato scab is caused by an organism which, if once introduced into the soil, will live there for many years. On freshly dug scabbed tubers, one can see a delicate white growth which consists of countless scab germs. The disease is spread by planting

affected potatoes or those which have been in contact with scab-bed seed.

Before the scab organism was discovered, the disease was attributed to any of these causes: too much moisture, heavy or rich soil, too much manure, excessive amounts of lime or ashes, and insects. Some of these may influence the development of scab but do not directly cause it.

CONTROL MEASURES

CORROSIVE SUBLIMATE

Corrosive sublimate, 4 ounces to 30 gallons of water, has proved the best disinfectant for controlling potato scab under Wisconsin conditions. It is also the best control for Rhizoctonia and black leg. Since the chemical dissolves slowly in cold water, it should first be stirred into about a gallon of hot water.

The strength of the corrosive sublimate solution can best be maintained by adding ½ ounce for every 4 bushels of seed potatoes treated and keeping the volume of water constant. This additional amount is based on the 1½ to 2 hour treatment. If a shorter treatment is given, a correspondingly smaller amount of chemical should be added. For example, if 4 bushels are soaked 30 minutes, add ⅛ ounce of corrosive sublimate. For convenience have the corrosive sublimate in a stock solution, strength 1 ounce to 1 quart of water, made up in fruit jars or stone crocks.

Treat only sound, uncut tubers before the sprouts have started. Dry the tubers at once after treatment to prevent continued action of the chemical. In case of damp, slow-drying weather the tubers should be rinsed with clean water immediately after treatment. Keep in clean crates or sacks in half light for 10 days to two weeks before planting. This prevents reinfection and allows strong sprouts to start. Do not place the potatoes in direct sunlight because they will get too hot and develop black heart.

Barrels, or wood or cement tanks are frequently used in treating potatoes. The tubers may be handled loose or in crates or sacks. If sacks are used they should first be washed and disinfected; this prevents weakening of the disinfectant.

Galvanized tanks may also be used if the interior is coated with asphaltum paint.

Cautions. Corrosive sublimate is a deadly poison if taken internally; therefore, be very careful to keep it away from young children and all farm stock. Avoid over treatment either by too strong a solution or too long a time, as the eyes of the potato may be injured and germination retarded. Do not use treated potatoes for food.

FORMALDEHYDE[1]

Formaldehyde is sometimes used in treating potatoes. The standard strength is 1 pint to 30 gallons of water. The time of treatment usually is two hours. In these experiments a 30 minute treatment with corrosive sublimate was as satisfactory as two hours in formaldehyde.

Formaldehyde has been widely used for treating potatoes. Leading potato growers, however, found from long experience that it is not entirely satisfactory in controlling scab under Wisconsin conditions. Comparative trials of various methods and practices were made in order to determine the best recommendations for Wisconsin growers. As a result greater emphasis is now being placed on the use of corrosive sublimate.

SELECT SCAB-FREE TUBERS FOR SEED

The greater the amount of scab on the seed, the greater will be the number of scab germs introduced into the soil, and the greater the amount of scab on the crop. The use of "leftover" and warehouse seconds is strongly discouraged.

PRACTICE CROP ROTATION

The best growers have demonstrated that it is not advisable to grow potatoes on any given field oftener than every third year. A rotation with grain and clover is desirable where a part of the cultivated crop may be corn. The plowing under of a crop of clover or fall rye before planting potatoes is a

[1] The use of hot formaldehyde 118° to 122°F. has recently been recommended in Iowa by Melhus and Gilman. In this method formaldehyde is used at the strength of 1 pint to 15 gallons of water. The potatoes are soaked 3 minutes, drained, and covered for 1 hour.

practice to be highly commended from the standpoint of maintaining the fertility and good physical condition of the soil and in the control of scab.

SELECT SCAB-FREE SOIL

Soils in different sections of the state, on different farms, and even in different fields of the same farm vary in the amount of scab organisms present. In general, the older sections and

FIG. 3.—BARRELS FOR TREATMENT

Barrels set upon a platform make good containers when a few bushels of potatoes are to be treated. Potatoes should be treated loose. The solution can be drawn off after treatment and the potatoes easily emptied and spread to dry.

fields long used for potatoes will have the most scab. A farm plan will greatly assist in locating fields where potatoes should or should not be planted.

AVOID HEAVY APPLICATIONS OF LIME, WOOD ASHES, OR MANURES JUST PREVIOUS TO PLANTING

If the soil is too acid and needs lime, it should be applied *after* rather than *before* the potato crop. Good results have been secured by applying manures to the clover field the year previous to using it for potatoes.

AVOID FEEDING UNCOOKED SCABBED POTATOES TO STOCK

Experiments have shown that the scab organism may pass through the digestive tracts of animals without losing its power to produce the disease.

FIG. 4.—A CEMENT TREATING TANK

Potatoes are conveniently handled in crates. A cement tank with a central partition may also be used in preparing solutions of copper sulphate and milk of lime for making bordeaux mixture. Compare front page and figure 3 for different containers.

DISINFECTION EXPERIMENTS

Experiments of 1916–1917. The object of the experiments was to compare corrosive sublimate and formaldehyde in the control of scab when both clean and scabbed seed were used.

The results of extensive work done during the seasons of 1916 and 1917 at the Wisconsin Experiment Station, Madison, are presented in Tables I and II. Further work was done from 1918 to 1920 in Waushara County, Barron County, and at the Wisconsin Branch Station, Spooner.

In these plots there were 143 units or treatments, of which 119 were devoted to the Rural New Yorker and Green Mountain—the two leading standard late varieties of Wisconsin. In-

cluded in the remaining 24 units were the Burbank (late variety), Irish Cobbler, Triumph, Early Ohio, and Early Rose (early varieties). The average number of plants in each unit or treatment was 50. In the plots there was a total of 23 controls planted to clean seed and 13 controls planted to scabbed seed. Clean seed and scabbed seed were used both in treated and untreated units.

The potatoes in all experiments were selected with care as to uniformity in size, type, and quality. In units where scabbed seed was used, stock with uniform infection was selected.

TABLE I.—AVERAGE OF RESULTS, SEED POTATO DISINFECTION AT EXPERIMENT STATION PLOTS—1916 AND 1917

Rural New Yorker variety

	Treatment	No. of units	Per cent scab
Clean seed	Corrosive sublimate	14	3.5
	Formaldehyde	4	10.0
	Untreated	8	20.0
Scabbed seed	Corrosive sublimate	12	11.0
	Formaldehyde	5	20 0
	Untreated	6	52.5

Corrosive sublimate and formaldehyde were used as disinfectants. The corrosive sublimate was used at a strength of 4 ounces to 30 gallons of water (1 to 1000), and potatoes were treated 1½ hours. Formaldehyde (40% solution) was used at a strength of 1 pint to 30 gallons of water, and potatoes were treated 2 hours. The water was kept at about 16°C. (60°F.) throughout all experiments. The potatoes were dried immediately after treatment. They were planted by hand 4 to 6 inches deep in rows 3 feet apart, with plants 16 inches apart in the row. Neither the appearance of the tubers nor the stand indicated any injury as a result of the treatments.

The soil in these plots was in part a medium silt loam and in part a medium clay loam. Both spring plowing and fall plowing were tried resulting in practically no difference in the amount of scab on the crop.

The season of 1916 was hot and dry. It was observed that under these conditions the development of scab throughout the state was rather pronounced. The seasons of 1917 and 1918 were fairly normal in both temperature and moisture.

The results obtained from seed disinfection are summarized in graphic form as averages of the various treatments on all plots devoted primarily to the Rural New Yorker variety. Comparable results were obtained with the Green Mountain and Burbank varieties.

TABLE II —AVERAGE RESULTS, SEED POTATO DISINFECTION AT EXPERIMENT STATION PLOTS—1916 AND 1917

Irish Cobbler, Early Ohio, Triumph, and Early Rose (early varieties)

	Treatment	No. of units	Per cent scab
Clean seed..	Corrosive sublimate	3	2.5
	Formaldehyde.....	1	23.5
	Untreated..... ...	8	45.5
Scabbed seed..	Corrosive sublimate	3	28.5
	Formaldehyde.....	1	56.5
	Untreated.....	5	61.0

The results indicated by the percentage of scab on the product from treated and untreated seed, both clean and scabbed, show that corrosive sublimate is more effective than formaldehyde in the control of potato scab. Formaldehyde, however, reduced the scab considerably.

The product from treated scabbed seed showed more scab than that from treated clean seed. Possibly some of the germs adhering to the irregular scabbed areas resisted treatment, or, on the other hand, they may have been protected by air bubbles, which are more likely to form on scabbed seed than on clean seed immersed in a liquid.

The product from untreated scabbed seed showed a higher precentage of scab than that from clean seed controls (untreated). This is reasonable, since scabbed seed supposedly has a much larger number of germs on its surface than the

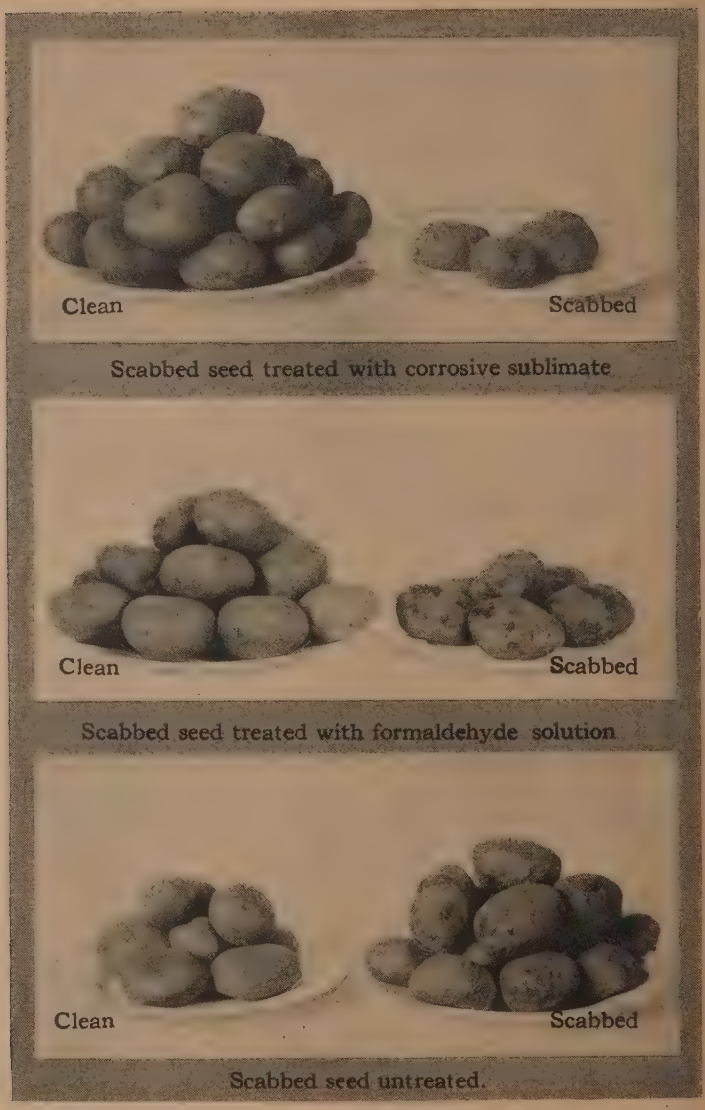


FIG. 5.—COMPARATIVE RESULTS OF 1917 EXPERIMENTS WITH SCABBED SEED

FIG. 6.—COMPARATIVE RESULTS OF 1917 EXPERIMENTS WITH CLEAN SEED

apparently clean seed. Since in this way more germs are introduced into the soil, it is expected that a higher percentage of scab will result when scabbed seed is used.

The tuber surface infection in the product from untreated scabbed seed was very much higher than that from untreated clean seed. The percentage of scab given, therefore, is not a true indication of the relative amount of infection of tubers, since equal consideration was given to a tuber having only one scabbed spot and one with a heavy surface infection.

The results show clearly the value of seed disinfection and also that the disease may be increased by planting scabbed seed stock. It is recommended, therefore, that growers select seed as free from scab as possible, whether or not it is to be treated.

Experiments of 1918. The objects of these experiments were: (1) to compare corrosive sublimate with formaldehyde in the control of scab, whether or not the tubers treated were previously soaked in water, and (2) to determine the effect of these chemicals on the control of scab when tubers were subjected to treatment for a duration of ½, 1, 1½, and 2 hours, respectively.

Corrosive sublimate at a strength of 4 ounces to 30 gallons water, and formaldehyde 1 pint to 30 gallons water, were used. The seed used was in part badly scabbed and in part relatively free from scab.

The soil in the Waushara County plot was a medium dark sandy loam, very uniform in texture. The main field in which the plot was located had been planted to potatoes in 1911 and again in 1914. As indicated by the untreated units, scab germs, no doubt, were present to some extent in the soil. The Late Ohio was used in all the units of the plot.

The results of these experiments indicate that the 1½ hour to 2 hour treatment in corrosive sublimate is more effective in scab control than the ½ hour treatment. However, the shorter treatment may be used if treatment must be delayed.

Seed soaked in water previous to treatment with corrosive sublimate gave a product that had less scab than the product from unsoaked seed. This appears to indicate either that water had some beneficial influence by washing off some of the scab organisms or in soaking up the tissue about the scab spots

so that it would be more readily penetrated by the disinfectants.

TABLE III.—SEED POTATO DISINFECTION FOR DIFFERENT LENGTHS OF TIME—LATE OHIO VARIETY, WAUSHARA COUNTY, 1918

Treatment	Time	Per cent scab
Corrosive sublimate	*Hours*	
Potatoes not soaked	½	25.5
Soaked 24 hrs. in water	½	17.0
Potatoes not soaked	1	7.5
Soaked 24 hours in water	1	4.5
Potatoes not soaked	1½	7.0
Soaked 24 hrs. in water	1½	10.0
Potatoes not soaked	2	13.5
Soaked 24 hrs. in water	2	2.0
Untreated		
Potatoes not soaked		64.0
Soaked 24 hrs. in water		65.0
Corrosive sublimate (selected seed, clean)	1½	5.5
Formaldehyde (selected seed, clean)	1½	20.5
Untreated (selected seed, clean)		53.0

The average of results shows that formaldehyde is not as effective as corrosive sublimate in the control of scab. This is shown clearly in the units where scabbed seed was used and confirms the reports received from the leading growers of the Wisconsin Potato Growers' Association.

Experiments of 1919. The objects of the experiments were: (1) to compare corrosive sublimate with formaldehyde solution (both hot and cold) in the control of potato scab, and (2) to determine the effect of these chemicals in the control when tubers were treated ½, 1, 1½, and 2 hours, respectively.

Corrosive sublimate was used at the strength of 4 ounces to 30 gallons water, and formaldehyde at 1 pint to 15 gallons water in hot solution and 1 pint to 30 gallons water in cold solution. Both scabbed and relatively clean seed were selected

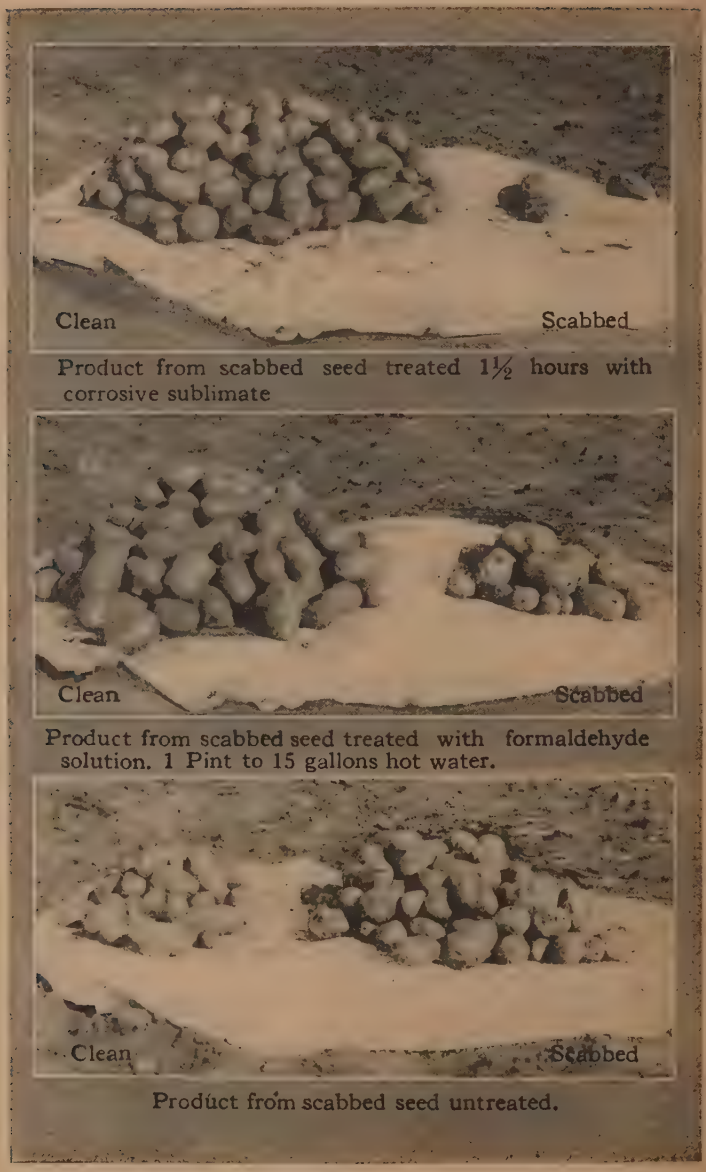

Clean
Scabbed
Product from scabbed seed treated 1½ hours with corrosive sublimate
Clean
Scabbed
Product from scabbed seed treated with formaldehyde solution. 1 Pint to 15 gallons hot water.
Clean
Scabbed
Product from scabbed seed untreated.

FIG. 7.—YIELD OF THREE 50 HILL UNITS SORTED FOR SCAB. EXPERIMENTS OF 1919

with care. Potatoes of the Late Ohio variety were selected from the same bin for both plots.

The soil in the Waushara County plot was a medium sandy loam of a very uniform texture. The soil in the Barron County plot was a medium clay loam of relatively uniform texture. Both soils had been cropped several times to potatoes, in a three-year system of rotation.

The plots at each place consisted of 25 rows (units) each containing 65 hills.

TABLE IV.—RESULTS OF SEED POTATO DISINFECTION—WAUSHARA COUNTY, 1919

Condition of seed	Treatment	Time	No. of units	Per cent of scab
		Hours		
Relatively clean.....	Corrosive sublimate	2	3	5.5
"	Untreated (control).	0	3	34.5
Scabbed.....	Corrosive sublimate	½	1	15.0
"	"	1	1	11.0
"	"	1½	1	7.0
"	"	2	1	1.5
Scabbed.....	Formaldehyde (cold 16°C. 61°F	½	1	44.0
"	"	1	1	37.0
"	"	1½	1	26.0
"	"	2	1	30.5
		Minutes		
Scabbed.....	Formaldehyde, 54°C 129°F.. ...	1	1	32.5
"	"	2	1	20.5
"	"	3	1	19.0
"	50°C. 122°F.	4	1	24.0
"	50°C 122°F.	5	1	24.0
Scabbed.....	Untreated (control)..	0	6	63 0

Corrosive sublimate was more effective than formaldehyde (cold or hot solution) in the control of potato scab. This is shown clearly in the units where scabbed seed was used. Hot formaldehyde was more effective than cold formaldehyde and less effective than corrosive sublimate.

The half-hour treatment in corrosive sublimate was not as effective as the longer treatments. This method is not recommended except where seed is especially clean or in cases where treatment has been delayed until the sprouts have started. The results, however, indicate that this treatment is as effective as the longer treatments with formaldehyde (cold solution).

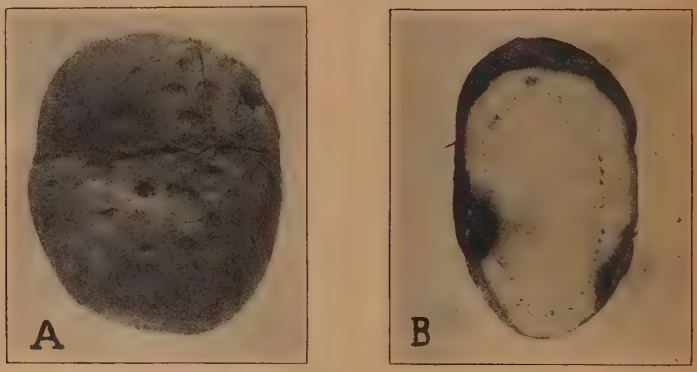


FIG. 8.—DON'T OVER-TREAT

A—Treated for 12 hours.
B—Section of injured tuber. Tubers treated when dormant are little subject to injury. If possible, treat potatoes from 10 days to two weeks or more before planting.

The percentage of scab decreased with the increase in the time of treatment, although there were some variations conflicting with what might have been expected. Any slight variations may be attributed to variable amounts of the scab organism in the soil.

The results of the experiments carried on in Barron County confirm in general those obtained in Waushara County.

Experiments of 1920. The objects of these experiments were: (1) to repeat the trials of corrosive sublimate in comparison with cold and hot formaldehyde, (2) to test the value of copper sulphate and inoculated sulphur, and (3) to determine the value of selecting seed apparently free from scab in the control of the disease.

The results at the end of the season showed that where the seed tubers had been treated with corrosive sublimate, the scab infection ranged from slight to medium in amount, with no cases of bad scab that would seriously disqualify for the

commercial market. The scab infection where formaldehyde has been used on the seed was somewhat more severe than with the corrosive sublimate treatment. There was practically no difference between the hot and cold formaldehyde. Where inoculated sulphur was harrowed into the soil at the time plants were coming through the ground, there was practically no difference between the treated and untreated plots. The copper sulphate treatment did not show sufficiently definite results so that safe conclusions could be drawn.

The control of scab by selecting apparently scab-free seed is a practice that can be recommended. The number of tubers that showed scab spots was greater than in many of the treated plots, but the extent of scab infection on the field run of the crop was distinctly less than where unselected seed tubers were planted. Furthermore, the result from such seed selection in the control of black scurf (Rhizoctonia) is much more important than with scab. Seed selection and treatment, therefore, are farm practices that can be most highly commended for the control of black scurf and scab.

Effect of Treating Successive Quantities of Potatoes In the Same Solution

In connection with the 1917 Madison experiments, 32 units were devoted to treating successive amounts of potatoes in the same solution of corrosive sublimate. Approximately ½ peck lots were used. Each lot was treated 1½ hours. One pint samples of the original solution and of the solution after each of the four successive treatments were taken for chemical examination. Analysis of the strength of each solution was made by the Division of Feed and Fertilizer Inspection, Wisconsin State Department of Agriculture. The results of analyses showed that the corrosive sublimate decreased in strength with each succeeding treatment. Since this was the case, it was expected that more scab would be present on the potatoes receiving later treatment. That this is true is shown in Tables V and VI.

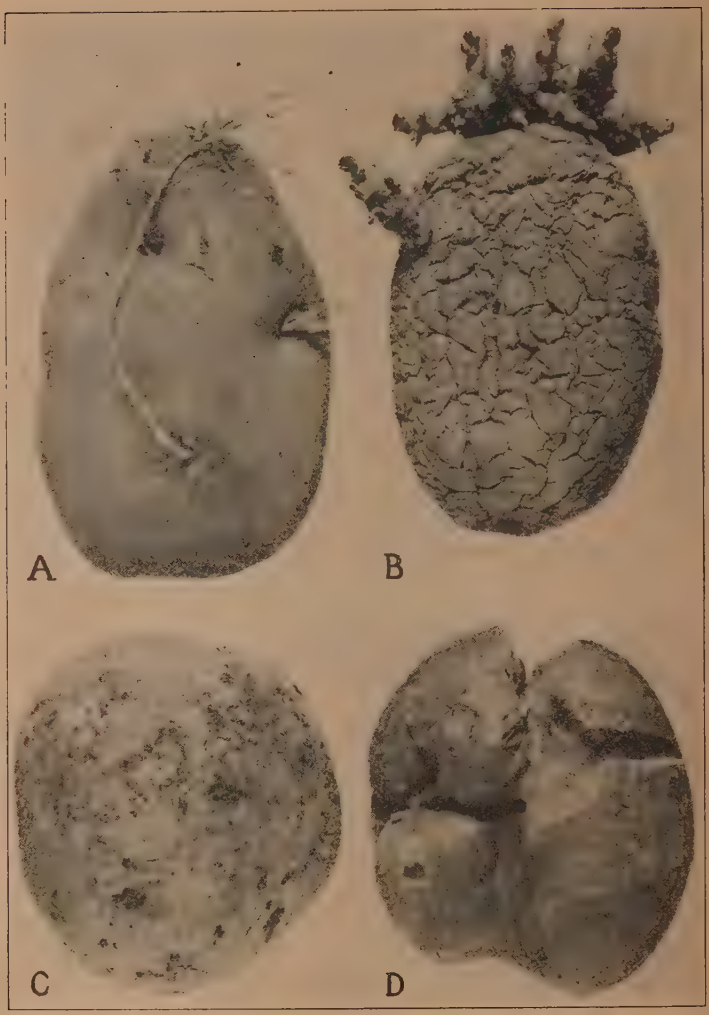


FIG. 9.—IT DOES NOT PAY TO PLANT OR TREAT INFERIOR SEED STOCK

A—Spindle sprouts indicate low vitality.
B—Excessively shriveled tuber indicates vitality lost through storage at too high temperature.
C—Black scurf or Rhizoctonia.
D—Growth cracks.

TABLE V.—RESULTS OF TREATING FOUR SUCCESSIVE AMOUNTS OF POTATOES IN THE SAME SOLUTION OF CORROSIVE SUBLIMATE—RURAL NEW YORKER VARIETY[1]

Number of treatment and condition of seed	Per cent scab			Average per cent scab	
	Exp. 1	Exp. 2	Exp. 3	Exp. 1, 2, 3	
1 clean	1.5	3.0	2.5	2.5	
1 scabbed	14.5	7.0	.....	10.5	
2 clean	5.5	7.0	2.0	4.5	
2 scabbed	17.5	7.5	.....	12.5	
3 clean	5.0	4.5	2.0	4.0	
3 scabbed	16.0	12 0	.....	14.0	
4 clean	5.0	4.5	8.0	6.0	
4 scabbed	23.0	14.5	.....	18.5	
Untreated					
Clean	15.0	11.5	19.0	15.0	
Scabbed	46.5	43 0	.....	45.0	

[1] Relatively free from dirt and with no visible scab spots.

The results show that there is an increase in the percentage of scab in the product of each successive unit of seed treated. It is reasonable to infer that the increase in scab is a result of decrease in the strength of the corrosive sublimate solution which, according to chemists, is due to a combination of a portion of the corrosive sublimate with the organic matter of the outer portion of the tuber. Table V indicates that a slightly greater loss occurs when scabbed tubers are treated than when clean seed is treated.

Another experiment was conducted to determine the loss of strength of the corrosive sublimate, by treating 12 consecutive lots of potatoes in the same solution. Analysis was made of the solution after each treatment. The results are given in Table VI.

Corrosive sublimate loses strength with each successive treatment. Unless the solution is strengthened each time by addition of more of the chemical but little germicidal action will result after the third or fourth treatment.

TABLE VI.—LOSS OF STRENGTH OF CORROSIVE SUBLIMATE WITH TREATMENT OF 12 CONSECUTIVE LOTS OF POTATOES

Treatment	Per cent of standard strength[1]
Original solution	91.0
After 1st treatment	75.0
" 2nd "	66.0
" 3rd "	55.0
" 4th "	46.0
" 5th "	35.0
" 7th "	26.0
" 9th "	16.0
" 12th "	6.5

[1] Standard strength solution of corrosive sublimate is 4 ounces to 30 gallons of water, or 1 part of the chemical to 1000 parts of water.

Where relatively small amounts of potatoes are to be treated, it has sometimes been found convenient to increase the time of treatment for the second lot to 1¾ hours, for the third lot to 2 hours, and that for the fourth lot to 2¼ hours, where no chemical has been added. This practice, however, has not been established by definite experiments under Wisconsin conditions.

INFLUENCE OF SOIL TREATMENTS ON SCAB

Experiments were conducted at Madison in 1916 to determine the influence of manures, lime, wood ashes, and sulphur on the development of scab. The soil in the plots was a medium clay loam. The manures were applied to the surface in a relatively fresh condition and were carefully worked into the soil. The same practice was followed in applying the other materials. The rate of application, the number of units or individual experiments, and the percentage of scab are given in Table VII. Rural New Yorker and Green Mountain, the two leading late varieties of potatoes in Wisconsin, were used.

The potatoes grown in plots receiving applications of horse and cow manures had the highest percentage of scab, and this was a decided increase over that in the controls. Field observations during five seasons support these results. The reason for this increase is rather difficult to explain. The manures

may exert some physical influence on the soil which is favorable to the development of the scab organism. Moreover, it has been noted that manures, especially horse manure, favor the growth of organisms which belong to the same group as the scab organism.

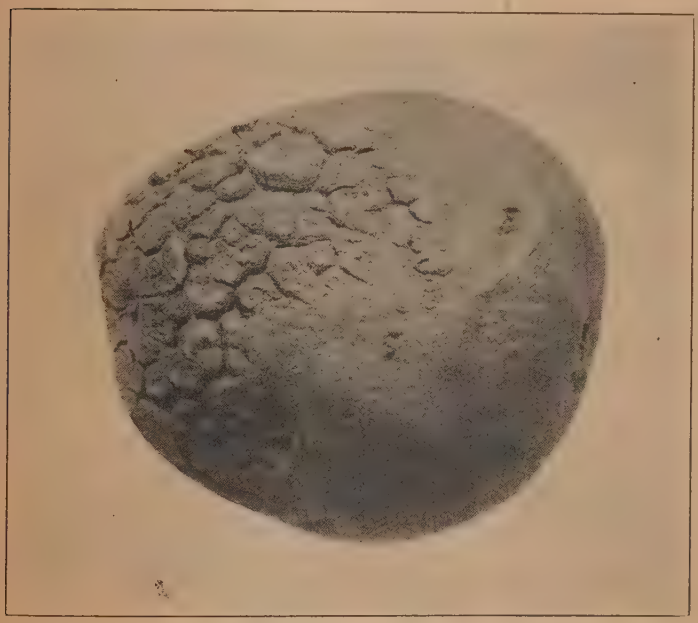


FIG. 10.—ROUGHENED SURFACE

This checked condition may be caused by unfavorable soil conditions, especially in heavy soils. It is sometimes confused with scab and black scurf injury.

The amount of surface infection by scab on tubers from manured plots was much greater than in the controls. Therefore, the percentage given is not a true indication of the relative infection. A high percentage of tubers in the fertilized plots would grade second quality because of their unsightly appearance.

Air slaked lime and unleached wood ashes added to the soil increased scab. These materials reduce the acidity of the soil and no doubt produce a condition favorable to the development of scab. It is generally supposed that the scab organism

is favored in its growth by a soil which does not give an acid reaction.

In general, results show that the most scab occurred in the units receiving the heaviest applications. A gradual reduction occurred as the amount of manure, lime, or wood ashes was reduced.

TABLE VII.—RESULTS OF EXPERIMENTS ON THE INFLUENCE OF CERTAIN SOIL TREATMENTS ON SCAB

Average of Rural New Yorker and Green Mountain varieties

Treatment	Amount per acre	No. of units	Average per cent scab
Horse manure (fresh)	25.0 T	2	73
	12.5 T	2	69
	7.0 T	2	56
Cow manure (fresh)	25.0 T	2	79
	12.5 T	2	71
	7.0 T	2	73
Lime (air slaked)	220 bu.	2	69
	110 bu.	2	62
	55 bu.	2	48
Ashes (wood)	200 bu.	2	62
	100 bu.	2	52
	50 bu.	2	39
Sulphur	900 lbs.	2	27
	450 lbs.	2	36
Tubers treated with corrosive sublimate:		4	3
Formaldehyde		3	7
Untreated potatoes or controls		10	39

In one plot, less scab occurred on the units treated with sulphur than on the controls. The percentage of scab increased with the decrease in the amount of sulphur applied. Results in another plot, however, showed no beneficial influence from sulphur. In view of these results and because of the high cost

of this treatment, sulphur cannot be recommended at this time. Inoculated sulphur may find a place for itself in the future, as experiments reported from New York and New Jersey show that it has some value in the control of scab when harrowed into the soil just before planting.

Both corrosive sublimate and formaldehyde reduced scab decidedly. Corrosive sublimate, however, proved the more effective.

FIG. 11.—SEED TREATMENT IS WORTH WHILE

Treatment reduces the danger of introducing disease germs into the soil with the seed. Potatoes should be laid out in half light on floor or canvas, either loose or in crates, to allow strong sprouts to form after treatment.

OCCURRENCE OF SCAB ON SIX STANDARD WISCONSIN VARIETIES

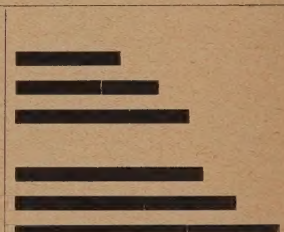
Along with the study of seed disinfection, there was opportunity to determine the occurrence of scab on six standard varieties of potatoes. Results were obtained by determining the average of scab in the product of control (untreated) units planted to clean or relatively clean seed. All varieties were planted at approximately the same date.

The lowest percentage of scab occurred on the Rural New

Yorker, one of the leading late varieties, and the highest percentage on the Irish Cobbler, a leading early variety. Field observations throughout leading potato sections, in connection with seed potato inspection covering six years, substantiate these results. They show that the late varieties have a lower percentage of scab than early varieties. Whether this is due to varietal susceptibility or whether some other factor or combination of factors is the determining agent remains to be decided through investigations now in progress at the Agricultural Experiment Station.

TABLE VIII.—OCCURRENCE OF SCAB ON SIX LEADING WISCONSIN VARIETIES

Varieties	No. of units	Average per cent scab
Late varieties		
Rural New Yorker	17	24
Burbank	10	32
Green Mountain	9	40
Early varieties		
Early Ohio	11	44
Triumph	5	51
Irish Cobbler	7	62



During the hot summer of 1916, scab was especially severe. That temperature may be an important factor seems plausible as a result of the investigations of the past year. Greenhouse experiments show that a moderately high temperature favors the development of the disease. Since the early varieties usually develop tubers during the hotter portion of the season, it is reasonable to suppose that if relatively high temperature favors the disease these varieties will have more scab than the later varieties, which usually develop when the temperature is much lower.

A tendency was noted also toward heaviest scab infection on the stem end of tubers. This was especially true of the Burbank variety. This would indicate that infection took place in the early development of the tuber during the hotter portion of the season. It appears that the enlargement of the scab areas is associated with the growth of tubers.

Another indication that scab develops early in the season is that the scabbed potatoes average considerably higher in weight than the clean stock. Their increase in size is, of course, due to a longer period of growth.

Field observations and reports by growers indicate that when the early maturing varieties are planted late they do not have as high a percentage of scab as those planted earlier. This is particularly true of Triumph. This merits consideration since other diseases, as tip burn and various leaf troubles, also occur less severely in late-planted early varieties.

TREAT SEED POTATOES

Control scab, black scurf, and black leg.

Corrosive sublimate is the best disinfectant to use.

Treat uncut seed; if possible treat it ten days or two weeks before planting.

The proper strength is 1:1000, or 4 ounces to 30 gallons of water.

The time of treatment recommended is 1½ hours for dormant seed; if seed has commenced to sprout, reduce the time but soak at least ½ hour.

Keep up strength of solution by adding ⅜ ounces of chemical after treating each 4 bushels of potatoes 1½ hours and restoring the volume of water to the original 30 gallons.

Throw away the treating solution after the third or fourth treatment, when no chemical has been added. In this case, increase the time of treatment 15 minutes for each consecutive lot treated.

Use wood or cement containers, such as barrels or tanks. Galvanized iron tanks may be used if protected by asphaltum paint. Corrosive sublimate eats holes in unprotected metal.

Corrosive sublimate is a deadly poison if taken internally. Therefore, be very careful to keep it away from children and all farm stock. The solution is colorless, tasteless, and odorless, and likely to be mistaken for water if left exposed. **Do not use** treated potatoes for food.

Formaldehyde is sometimes used at the rate of 1 pound to 30 gallons. Soak the uncut seed 2 hours. In case sprouts have started, there is less injury than where corrosive sublimate is used. It is not as efficient as corrosive sublimate in controlling scab and black scurf.